GAMMA SPECTROSCOPY DATA COLLECTION FOR GASEOUS EMISSIONS AT ES-2 AND ES-3

Purpose

This Meteorology and Air Quality Group (MAQ) procedure describes the requirements for collection of adequate data for each emissions control configuration using the gamma spectroscopy systems on stacks TA-53-7-2 (ES-2) and TA-53-3-3 (ES-3) at LANSCE as part of the Laboratory's radioactive air emissions management program.

Scope

This procedure applies to the MAQ Radioactive Air Emissions Measurements team members (or designees) assigned to perform gamma spectroscopy data collection activities on the radioactive air emission monitoring systems for stacks ES-2 and ES-3 at LANSCE.

In this procedure

Signatures

Signature	Date
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04/20/05

General information about this procedure

Attachments

This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	Hazard Review	2

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description of Changes
0	6/22/93	New document, issued as HS-1/TA-53-STACK-DP-005.
1	7/22/94	Revised as ESH-1/TA-53-STACK-DP-005.
2	8/2/95	Revised into new format and process updated. Issued as ESH-17-605, R2.
3	3/10/97	Revised and reformatted. Issued as 53 FMP 104-05.3
4	5/25/01	Revised and reformatted. Issued as ESH-17-605, R4.
5	4/6/04	Included requirement to trend Full-Width Half Maximum (FWHM) of the 514 keV gamma peak during DQM runs, to resolve DR#358. Also, editorial changes to reflect current operations.
6	04/25/05	Replaced HCP with HR, other editorial changes throughout.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- Individuals assigned to perform activities in this procedure

Training method

The training method for this procedure is **on-the-job** training by a previously trained individual and is documented in accordance with the procedure for training (MAQ-024).

General information, continued

Prerequisites

In addition to training to this procedure, the following training is also required prior to performing this procedure:

- MAQ-011, "Logbook Use and Control"
- MAQ-603, "Calibrating the High Purity Germanium System Used on the Monitored Stacks at TA-53"
- Facility-specific training for unescorted access to TA-53 experimental areas: course #9693
- Limited access area training to access the ES-2 stack station in the MEB: course #18825

Definitions specific to this procedure

None.

References

The following documents are referenced in this procedure:

- MAQ-RN, "Quality Assurance Project Plan for the Rad-NESHAP Compliance Project"
- MAQ-024, "Personnel Training"
- MAQ-603 (formerly 53FMP 104-03), "Calibrating the High Purity Germanium System Used on the Monitored Stacks at TA-53"
- MAQ-604, "Performance Testing of the Kanne Air Flow-Through Ionization Chambers"
- MAQ-607 (formerly 53FMP 104-07), "Daily Surveys of Air Monitoring Equipment"
- MAQ-614, "Calculating Weekly Gaseous Radioactive Air Emissions from Sampled Stacks at TA-53"
- MAQ-617, "Cryogen Use at TA-53 Stack Systems"

Note

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").

Background and process description

Background

The monitored stacks at the Los Alamos Neutron Science Center (LANSCE), located at LANL Technical Area 53, are designated TA-53-BLDG-7-ES-2 and TA-53-BLDG-3-ES-3. For simplicity, the stacks are referred to in this procedure as ES-2 and ES-3, respectively.

Gas flow-through ion chambers (Kanne chambers) are used at stacks ES-2 and ES-3 to monitor radioactive gaseous effluent. The integrated charge from the ion chambers, multiplied by the stack flow, is proportional to the total curies discharged. However, to calculate the dose from the emissions requires that the total number of curies for each radionuclide discharged be determined. Ion chambers cannot provide this composition information. Therefore, high-resolution gamma spectroscopy and decay curve analysis are used to determine the fractional amounts of each radioactive constituent in the effluent. The quantitative emissions and fractional composition of each radionuclide are used by MAQ determine the off-site dose to the public.

Overview of data collection

Both ES-2 and ES-3 utilize the Canberra Genie 2000 software, with a High Purity Germanium (HPGe) detector, for data collection and analysis. MAQ performs the following types of data acquisitions at each stack. Complete descriptions are provided in specific chapters of this procedure.

- Pulse Height Analysis (PHA) runs, which look at the entire energy spectrum of the stack gas.
- Multi-Channel Scaling (MCS) runs which trend detection rates of positron-emitting radionuclides over time.
- Decay curve (DCY) measurement runs.
- Data Quality Measurement (DQM) runs.
- Special PHA runs are used to during detector calibrations (CAL) as described in procedure MAQ-603.

Acquisition file names

Acquisition files should be given unique filenames. In 2003 and 2004, the following naming scheme was used: STTTYYMMDD##

S = Stack identifier; “2” for ES-2, “3” for ES-3
TTT = Type of acquisition file; PHA, MCS, DCY, DQM, or CAL.
YY, MM, DD = year, month, and date the acquisition run was saved. E.g., 040312 is 2004, March 12.
is the number of that file type saved in that day. The first file is “01,” the second will be “02,” etc.

Example: 2PHA04030801 is ES-2, a PHA file, saved on March 8, 2004, and the first PHA file saved that day.

Background and process description, continued

Detector operating environment	The HPGe detector in use at the stacks must be maintained at liquid nitrogen temperature once stack emission monitoring operations have begun for every beam run cycle.
Caution regarding liquid nitrogen tanks	Liquid nitrogen (LN_2) is used to cool the HPGe detector. Follow MAQ-617 to fill the dewars. Use caution when filling the dewars, to prevent excessive splashing of the liquid nitrogen. Obey all safety instructions in the procedure.
Keeping records of work	Keep all raw data, notes, calculations, and graphs, generated at the sampling systems in the appropriate Stack Logbook for the current year; final results and printed reports generated under this procedure are to be filed in the appropriate notebook. Make all logbook entries in compliance with the requirements for logbooks (MAQ-011). File all records sequentially and ensure that records contain enough written detail that the measurements and calculations can be reconstructed without difficulty. The thought process should be clearly described.

Pulse Height Analysis measurement

Background

The Canberra Genie 2000 HPGe detector and data collection system are used for pulse height analysis (PHA) measurements and analyses. The extensive Canberra documentation is relied upon to provide the basic QA for this process. The system is based on well-established industrial and scientific techniques.

Canberra equipment setup

Before proceeding with data acquisition, assure that the HPGe detector has been calibrated according to procedure MAQ-603. The energy calibration and the energy-dependent efficiency curves are stored in Genie 2000 calibration files. The identifications of the current files are found in the Stack Logbook. Verify that the correct files are installed as default acquisition parameters before data collection begins. Calibration data will automatically become part of each new data acquisition file

Note: After calibration and system setup, the Genie 2000 software will automatically verify that the detector, amplifier, and ADC settings have not changed. If there is an unexpected change (e.g., such as might result from a power outage), the system will warn the operator that the data collected is suspect. The data files retain this warning. Such files will not be used for emissions determination unless such use is explained and documented in the Stack Logbook.

PHA data collection

Except during decay composition measurements, emissions experiments, emissions calibrations and testing, or other required activities, MAQ continuously collects PHA data using a HPGe detector that is directed towards a metal canister (the “gamma can”), through which a sample of the effluent gas flows. PHA acquisitions that are shorter than 2 hours are not as useful as longer runs because they do not represent the long-term average emissions.

Configuration changes

Any emissions configuration change (e.g., ventilating fan or damper changes that affects the air volume transportation time or the source of emissions) that alters the composition of the stack effluent can affect the stack flow rate and/or the radionuclide composition, and thus affect the radionuclide emissions. Treat each configuration separately with regard to analysis and emissions reporting.

Notify MAQ stack personnel of any configuration changes (to fans and dampers). The **stack team** will record any ongoing measurements prior to the configuration change. After any configuration change, **stack team** perform an evaluation to determine if measurements need to be made for the new configuration. In any case, ensure that all decisions and changes made to the system are logged into the stack logbook as the official record.

Pulse Height Analysis measurement, continued

Steps for PHA data collection

For PHA data collection, perform the following steps:

Step	Action
1	Record in the Stack logbook the fan/damper configuration and the beam current. If the beam is off but expected to resume, note the nominal current.
2	Simultaneously start the PHA run and note the integrated pC count recorded with the ion chamber electrometer. The run will be uniquely identified by date and the run number for that day at the time acquisition is stopped. Record this information in the logbook.
3	When it is time to halt data acquisition, simultaneously stop the PHA run and note the integrated pC count of the ion chamber electrometer. Record the integrated count in the Stack logbook and the associated data file name.
4	Genie 2000 provides a sample information screen for recording and storing a variety of information associated with a particular spectrum. Open the “Edit Sample Information” screen by clicking on the appropriate icon. Record the sample title, operator name, a brief description of the beam and ventilation operating parameters, the file name, the name of the calibration file currently in use, and the starting and ending integrator pC readings from the electrometer. **Note:** During beam operations, optimal acquisition time is 2 days. Longer times are acceptable during extended periods of low beam current or at team discretion. In any case, the PHA measurements should reflect only a single fan/damper configuration.
5	Save and store the spectrum with its associated calibration, acquisition parameters, and ancillary information on the hard disk with a unique name.
6	Several specialized analytical routines have been prepared by MAQ and are listed as analysis sequences under the analysis function of the Genie 2000 Gamma Acquisition and Analysis software. Use the appropriate Genie 2000 Analysis Sequence to analyze the PHA spectrum, and obtain a report of the results.
7	File the printed reports in the Stack Gas Measurements notebook for the current year. These reports will be used in determining the isotopic composition as described in MAQ-614.

Multi-channel scaling measurement

Background

Multi-channel scaling (MCS, the record of the number of recorded detected radiation interactions of a discrete energy per specified unit of time) data are collected nearly continuously and serve as a time history of the concentration of positron emitters in the flowing stack gas.

The MCS uses a Single-Channel Analyzer (SCA) to only collect data from a certain region of the spectrum. At LANSCE, this “window” is set around the 511 keV annihilation region, to record relative levels of positron-emitting radionuclides over time.

Note that the MCS measurements are not an essential part of stack emissions determination; the results do not typically enter into EPA reporting. Since the Genie 2000 can collect MCS data simultaneously with PHA data, the MCS data serve as a backup to the ion chamber data. The MCS data also provide additional information to the staff in interpreting emissions measurements and equipment performance. No special analysis is routinely required for these runs.

Recording MCS data

To take advantage of the additional information capability of MCS, make logbook entries that detail the configuration, the beam current, targets in use, delay line operation, and other pertinent information. Record this information in the Stack logbook and on the sample information page of the MCS data file.

Note that the MCS runs are not required to be stopped and started at configuration changes. MCS runs are frequently the most useful during configuration changes, since they provide a visual display of the effects configuration changes have on positron emissions.

Check SCA setting

Prior to a beam operating cycle and periodically throughout beam operation, the SCA setting must be validated by comparing the summed counts in an MCS run with the analyzed counts in the 511 peak of a simultaneous PHA or DQM run. This ratio should be calculated and recorded in the Stack logbook whenever a simultaneous run is made. If needed, the SCA window can be adjusted. Record any changes to the SCA settings in the logbook.

Starting and stopping MCS runs

MCS runs should be started and stopped while simultaneously recording the integrator reading of the stack ion chamber, in a manner similar to that described above for PHA runs. Store all MCS runs with a unique file name.

Decay curve measurement

Background

The MCS function of the measurement system can be used to determine the identity and fractional composition of positron emitters in a stagnant sample of the stack gas. The number of 511 keV positrons are recorded over 10 second intervals for about 2 1/2 hours after a sample is isolated. Since the gas sample is stagnant, the radionuclides in the sample are decaying away with time. The fraction of each radionuclide can then be determined by deconvoluting the decay curve to identify the constituent components.

Frequency of decay curve acquisitions and analyses

These measurements should be performed at least once per week during beam operations, and for every stack system configuration change that will change the effluent discharge rate or isotopic composition. For previously documented configuration settings, it is permissible to utilize historical information to document the constituents of the effluent. Historical information is useful during facility development on the system and for changes to the system that last less than a few hours. When historical information is used, fully document the action in the Stack logbook.

Note that at times of low beam operation, there may not be sufficient emissions data to obtain an accurate decay curve. Typically, count rates of 15-25 cps or more are required for decay analysis.

Sample flow valves at ES-3

When isolating the decay curve sample at Exhaust Stack 3 (ES-3) there are seven valves that require manipulation:

- Two pairs of valves used for isolating the sample can from the system. These valves are located at the end of the braided metal hose and the copper delivery tube near the HPGe detector.
- Two relief valves on each sample line. These valves are between each pair of isolation valves (above) and are used to relieve any vacuum between the sample can and the pump.
- A bypass valve located near the stack ion chamber. This valve is used to divert the sample flow from the gamma sample can directly to the ion chamber.

Under normal sample flow-through conditions, the valves should be in the following configuration: isolation valves open, relief valves closed, and bypass valve closed. (When a valve is closed, the handle is perpendicular to the line and when open, parallel to the line.)

Decay curve measurement, continued

Sample flow valves at ES-2

For the gas sample system at Exhaust Stack 2 (ES-2), there are only three valves: a pair of isolation valves (normally open during routine measurements) and a bypass valve to divert the air flow from the sample can directly to the 50 liter ion chamber. This bypass valve is normally closed during routine measurements.

Steps to acquire decay curve

Following a beam turn-on or configuration change, wait at least 1/2 hour for conditions to stabilize before starting a data acquisition to observe the sample decay rate.

To start data collection, perform the following steps:

Step	Action
1	Stop the PHA and MCS data collections. Record the pertinent information as described previously.
2	Set the MCS time interval for 10 seconds per channel (1E7 microseconds)
3	Start the acquisition on the MCS and the stopwatch simultaneously.
4	At exactly 200 seconds, close the isolation valves (labeled "A" at ES-3) that isolate the sample can. **Note:** Bin number 21 in the data file (assuming 10s/bin) holds the number of 511 keV photons detected immediately before the decay starts and therefore represents the mixed sample concentration at the start of the decay curve. Bin 21 represents the concentration at the start of the decay curve. Bin 22 is the first decayed point.
5	As soon as possible, switch the bypass valve (labeled "B" at ES-3) to send the gas to the ion chamber.
6	For ES-3 only: Close the remaining isolation valves (labeled "C") for the sample can (located closest to the copper lines).
7	For ES-3 only: Open the two relief valves (labeled "D") located between the two sets of isolation valves to complete the isolation.
8	After sufficient time has elapsed for data collection (typically 10,000 seconds), stop the acquisition.
9	Store the data on the hard disk with a unique file name incorporating the date and run number and the identifier of "DCY."
10	Return the system back to normal monitoring mode (gas flowing through the sample can then to the ion chamber) by performing steps 3 to 6 in reverse order and reversing the valve positions.

Steps continued on next page

Decay curve measurement, continued

Step	Action
11	Set the MCS time interval adjustment back to the appropriate time length for routine operation, typically 100 seconds per channel (1E8 microseconds)
12	Restart PHA and MCS measurements as described in the PHA and MCS measurement sections.
13	Open a new Genie 2000 Gamma Acquisition and Analysis application window, load the just-acquired MCS decay file as the datasource, and execute the Decay File Analysis sequence to create a report of the data in a format useful for analysis as described in MAQ-614.

511 keV counts/pC ratio

Background

This chapter describes counting the 511 keV annihilation radiation from the positron emitters in the flowing stack gas, counting the digitized charge collected by the ion chamber & electrometer, and determining the ratio of the two values. The ratio should normally stay fairly constant throughout the run cycle, and this stable ratio can be used to ensure proper performance of the two detectors.

However, if the counting geometry of the gamma system changes, the ratio will change. Changes in operating configuration (use of different target cells and/or operation of the gaseous emissions control systems) can also change the ratio. During start-up of beam operations or acquisition runs when there is a great deal of "beam off," this ratio can also change.

Steps to calculate 511/pC ratio

Perform this calculation periodically throughout the run cycle. To calculate the 511/pC ratio, perform the following steps:

Step	Action
1	Execute a standard Peak Search analysis sequence on the spectrum, and print a hard copy of the report. Divide the 511 keV peak area reported on the Peak Efficiency Report by the detector LIVE TIME. The result is the detected count rate of 511 keV photons.
2	Determine the number of picocoulombs (pC) detected by the ion chamber during the PHA acquisition. This is the difference between the integrator reading at the end of the run and the integrator reading at the start of the run. Divide this difference by the REAL TIME reported by the PHA run. From this ratio (in units of pC per second), subtract the electrometer background count rate, also in pC per second. This background count rate is determined prior to the run cycle (see procedure MAQ-604) and periodically re-measured during the cycle. The result of this subtraction is the corrected ion chamber count rate in pC/second.
3	Calculate the ratio of 511 keV counts per picocoulomb by dividing the detected count rate (511 keV counts per second) by the corrected ion chamber count rate (pC/second). The result is the 511 keV counts per picocoulomb ratio.
4	Record this ratio on the front page of the PHA report and file in the Stack logbook. Compare the value with the established value measured at other times throughout the run cycle or in previous run cycles with similar operating conditions. Record this value in a spreadsheet for electronic trending.

Performing configuration changes

Background

Fan and damper configuration changes are required for operational reasons including ALARA principles, emissions management, emissions calibrations, or experimentation. For each time period at a given configuration, PHA and MCS data are normally collected. Frequently, a decay curve will also be collected. The objective here is to ensure that data collection is completed and documented before a new configuration change is made. To change the configuration, perform the following steps:

Steps to change configuration

To change the configuration, perform the following steps:

Step	Action
1	The MAQ **stack team member** should be present before the configuration is changed so that emissions data acquisition can be stopped and restarted under the new configuration. However, if an extreme situation requires a configuration change before a member of the Rad Air Emissions team can arrive on-site, the ventilation may be changed by other personnel and the Rad Air Team can change the data recording as soon as possible thereafter. Qualified MAQ team members will be on 24-hour call while beam is on into Area A or the Lujan Center. Every effort should be made to contact the on-call person before making configuration changes. Contact information is posted at each sampling station, the TA-53 Central Control Room, and the HSR-1 Field Office.
2	Prior to making emissions configuration changes, the **MAQ team member** will stop the current PHA run while noting the integrated pC count of the ionization chamber as described earlier. The file name and integrator reading will then be recorded in the Stack logbook
3	The MAQ **stack team member** may decide to allow the MCS acquisition to continue through the configuration change; these periods frequently contain useful information (transient emissions effects). However, if it is appropriate to do so, the MCS acquisition may be terminated simultaneously with the PHA run. This might occur if the MCS is nearing the end of its allotted time channels, or if the configuration change is expected to be very long, or it is desired to have as a separate file for analysis.
4	The total counts in the MCS run are the total number of 511 keV gamma rays detected. Compare these to the net area under the 511 keV peak in the PHA file. These comparisons are used to validate the setting of the SCA, as described previously.

Steps continued on next page.

Performing configuration changes, continued

Step	Action
5	Make the configuration change.
6	Start the PHA (and MCS if necessary) acquisition.
7	MAQ **qualified staff** should evaluate the new stack concentrations for the current configuration and determine whether they are consistent with the expected values for the particular fan/damper configuration and the current wind conditions. **Note:** The evaluation is somewhat subjective but is useful in that the process may uncover errors or find the onset of a water leak in the beam line.
8	If the evaluation determines that the concentrations are different from what was expected, if the configuration is to be maintained for a long time, or if the configuration is unique, a new PHA should be started and consideration should be given to performing a decay curve.

Data Quality Measurements (DQM)

Background

To check the detector performance, the activity from a ^{85}Kr calibration can is measured and compared with the actual activity of the source. The 514 keV of ^{85}Kr is a good check for the 511 keV annihilation gammas that are the primary constituent of TA-53 gaseous emissions. Along with the detector efficiency, the DQM procedure also verifies that the axial distance between the gas sample can and the detector has not changed over the run cycle.

When to perform DQM

Performance checks must be performed periodically (at least monthly) throughout the beam operating cycle, and at least once before and once after the run cycle. Due to background interference during high-emissions times, it is best to wait for a maintenance outage or other "beam off" time to get the best quality reading.

Steps to perform a DQM run

To perform a DQM data acquisition run, perform the following steps.

Step	Action
1	Open the cover to the HPGe system and remove the gas sample can and its holder from the detector shield.
2	Place a small pyramidal-shaped dab of sealing putty on top of the detector endcap, so that the pyramid will compress when the can and holder assembly are put back into the HPGe shield.
3	Place the can and holder back into the HPGe shield system and push until holder assembly sits firmly on the bottom of the shield housing.
4	Remove the holder assembly again and carefully remove the Sealing putty material from the detector endcap, being careful not to deform the shaped material.
5	Measure the thickness of the material with a ruler to the nearest half millimeter. This thickness is the distance from the detector face to the sample can. If removing the material deforms it too much, repeat the measurement.
6	Take apart the sample can holder assembly and remove the gas sample can from the holder. Put the bottom of the holder and the spacer ring back into the HPGe shield system.
7	Repeat steps 2-5, this time using the calibration gas can.

Steps continued on next page.

Data Quality Measurements (DQM), continued

Step	Action
8	Record the two measurements in the stack logbook. The distances should be similar; within one millimeter. Due to the concave nature of the calibration can, the distance from the bottom of it to the detector surface should be about 0.5 mm greater than that of the sample gas can. If the distances vary throughout the run cycle, investigate any changes that may have been made (during liquid nitrogen refills, etc.). Repeat the distance measurements if necessary.
9	Replace the calibration can into the HPGe detector assembly, again lining up the can weld with the gap in the spacer ring.
10	Start a PHA run to determine activity of the sample can. Acquire the spectrum for at least 1000 seconds (16 minutes, 40 seconds).
11	After data acquisition is completed, stop and save the PHA run with a unique filename and the "DQM" file type identifier.
12	Remove the calibration can from the detector shield, and replace the "gamma can" in its framework inside the shield.
13	Begin normal PHA data acquisition as described in previous chapters
14	To analyze the recently-acquired DQM run, open a new Genie 2000 Gamma Acquisition and Analysis application window, and load the DQM file as the datasource.
15	Execute the "ES-3 [or ES-2] DQM Analysis" sequence. This program will provide the following reports: Peak Locate, Peak Area, Efficiency Corrections, and Nuclide Identification (NID). The NID report lists the activity of the Kr-85 calibration can with associated counting error.
16	Find the actual activity of the calibration can. To do this, decay correct the calibration can activity to today's date. • The Kr-85 measured activity was 88.9 µCi on September 24, 1992. • The half-life of Kr-85 half-life is 10.73 years.
17	Determine the 514 keV gamma emission rate for the can. To do this, use the actual activity of the Kr-85 calibration can calculated above, and convert to disintegrations per second (dps). Multiply this value by the 514 keV gamma yield. • There are 3.7E4 disintegrations per second per microcurie. • The 514 keV gamma yield for Kr-85 0.00434
16	Record both the reported activity (from the DQM analysis) and actual activity in the stack logbook. Compare the actual activity with the measured activity. The measured activity should be within the stated error bars (at 2 sigma) of the actual activity, or about 3%.

Steps continued on next page.

Data Quality Measurements (DQM), continued

Step	Action
18	Since the peak efficiency generated and reported with the peak search routine are used to determine emissions (in MAQ-614) it is important to verify that the efficiencies calculated are consistent over time. The actual efficiency of the detector is determined by calculating the ratio of detected 514 keV counts per live time, and dividing this count rate by the actual gamma emission rate of the source determined above.
19	Record both the reported efficiency from the DQM analysis, and the actual measured efficiency. The reported value should be within 2% of the actual value.
17	If the reported activity or the reported efficiency is not within desired ranges of the actual values, examine the system for possible errors (calibration can not set flat in the holder, etc.). Take the DQM run again. If the values are repeatedly off, the detector may require recalibration.
18	Another measure of detector performance is the detector resolution, as measured by the “Full Width at Half Maximum” (FWHM) of the 514 keV peak. Using the graphical interface of the Genie 2000 Gamma Acquisition & Analysis window, determine the FWHM of the 514 keV peak for this run. An increase in the FWHM over time can indicate a degradation of detector resolution. In this case the detector might need a thermal cycling (complete warm-up and cool-down). Other causes of an increased resolution include the slow failure of a component of the HPGe electronics package.
20	Trend the results of DQM information throughout the run cycle: activity response, efficiency response, and FWHM. Positive or negative trends may indicate a problem with the detector system. Note any trends in the stack logbook and recalibrate the system if required, according to procedure MAQ-603.

Records resulting from this procedure

Records

The following records generated as a result of this procedure are kept in the offices at LANSCE and are periodically copied and submitted as records to the MAQ records coordinator:

- any raw data, notes, calculations, graphs, and final results stored in the Stack Gas Studies book
- printouts of PHA files, DQM tests and Decay Curve analyses
- Electronic data files of performance trends, stored on the Projects drive of the MAQ computer network.

HAZARD REVIEW FOR GAMMA SPECTROSCOPY DATA COLLECTION

Work tasks/Steps	**Hazards, Concerns, and Potential accidents; Likelihood/ Severity**	**Controls, Preventive Measures** *(e.g., safety equipment, administrative controls, etc.)*	**Hazard Level** *from IMP 300-00-00 Hazard Grading Matrix*
Task: Perform data collection according to steps in this procedure.	Non-accountable radioactive sources – handling radioactive sources used in calibration; rupture or release of source could cause contamination Rad Sources: occasional / moderate = low	Handle rad sources with care. Mixed gamma point sources must be handled by the outer ring only. Volume (can) sources of Kr-85 gas must not be dropped or caused to "vent" the can contents. Use ALARA techniques. Low-level rad: wear dosimetry as directed by facility-specific training. Practice ALARA techniques when in radiation fields or handling sources.	Low
Perform work in ES-2 stack building.	Radiation exposure – exposure to low-level radiation fields from stack air & sources; accident scenarios at ES-2 stack (1L Target rupture, collect rad material in HEPA filters) remote / critical = minimal	Accident scenarios: keep access training up-to-date; be aware of alarms; wear appropriate dosimetry as required by limited-access training.	Low

Wastes or residual materials resulting from process

None.

Emergency actions to take in event of control failure	For all injuries, provide first aid and see that injured person is taken to Occupational Medicine (only if immediate medical attention is not required) or the hospital. During LANSCE accelerator operation, the Central Control Room (CCR) and HSR-1 offices are staffed 24 hours, 7 days. Contact these offices for assistance as needed. CCR: 667-5729; Building 4, room 203. HSR-1 Field Office: 667-7069, Building 395, room 101.